

A REVISION OF THE NEW CALEDONIAN SPECIES
OF *OSMANTHUS* *

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THROUGHOUT MUCH OF THE OLEACEAE generic limits are obscure; particularly is this so in the Tribe Oleae, and until detailed revisions on a world basis have been completed it is in many ways advisable to take a broad view of genera. In consequence of this the species included in this revision are treated as members of the genus *Osmanthus* Lour., notwithstanding the fact that Johnson, in his relatively recent review of the family (Contr. New S. Wales Natl. Herb. 2: 295–318. 1957), segregated them, along with some other Australasian species, in the resurrected genus *Nestegis* Raf. (*Gymnelaea* (Endl.) Spach). These New Caledonian species, however, differ from the other members of *Osmanthus* in their inflorescence characters and should be recognized as constituting a separate section. This is proposed and described below.

In addition to being treated in *Nestegis*, which has been characterized by the possession of a decussate inflorescence together with either no corolla or one in which the aestivation of the lobes is imbricate, these species have at times been classified in the genus *Notelaea* Vent. However, although the basic inflorescence type is similar throughout the whole Pacific complex, the true members of this last genus are distinguished by their induplicate-valvate corolla lobes. Three of the species maintained in this revision were first classified as *Notelaea* but other New Caledonian plants which have been described in this latter genus are excluded from *Osmanthus* by characters of the flowers. The first such species described was named *Notelaea brachystachys* and the type specimen, one of the only flowering specimens of this group, bears flowers with induplicate-valvate corolla lobes arranged in two pairs and appearing as though, when fully developed, they would be long in proportion to their breadth. This suggests the genus *Linociera* with many species in Malaysia and a few outliers in Australasia. The appearance of the other species, *N. francii* Guillaum. and *N. paniculata* Guillaum., would also suggest *Linociera*, as does that of *Sarlina cylindocarpa* Guillaum., a relatively newly described monotypic genus.

I should like to express my grateful thanks and appreciation to the directors and curators of the various herbaria cited in this revision, either for the loan of material or for facilities to study. All the material cited has been examined and the respective herbaria are indicated by the abbreviations published in the *Index Herbariorum*. I should particularly

* Results of the Botanical Expedition to New Caledonia 1950–52 (French-Swiss Mission).

like to thank Dr. H. Hürlimann, of Basle, for help with information about the habitats of *Osmanthus austro-caledonicus*, and Miss Judith Kroll for the drawing and diagrams used to illustrate this paper.

Osmanthus Sect. Notosmanthus P. S. Green, sect. nov.

Ab aliis sectionibus inflorescentiis decussatis differt. Folia integra. Inflorescentiae axillares decussatae. Flores androdioecii. Corolla tuba brevicanpanulata, lobis quattuor imbricatis. Antherae 1–2.2 mm. longae, appendice terminali parva.

Evergreen shrubs or small trees up to 10 m. in height, branches glabrous or puberulous when young. *Leaves* glabrous or minutely puberulous towards the base of the midrib when young, lamina thick coriaceous; margin entire, slightly thickened; apex acute to rounded; venation obscure or reticulate. *Inflorescence* axillary, decussate with terminal flower, 1–6 per axil from 1–2 superposed buds, 1.5–6 cm. long with 5–13 flowers per rachis, sometimes the five terminal flowers subumbellate; bracts narrowly triangular-linear to more or less ovate or subfoliaceous. *Flowers* androdioecious. *Calyx* 1–2.5 mm. long with 4 somewhat irregular more or less triangular lobes 0.5–1.5 mm. long. *Corolla* short campanulate, tube 1.2–2.8 mm. long, lobes 4, broadly ovate, rounded, imbricate in bud, 0.7–2.5 mm. long. *Stamens* 2, subsessile near the middle of the corolla tube, anthers 1–2.5 mm. long, the largest in male flowers, with a slight terminal appendage often barely discernible. *Ovary* 1.7–2.5 mm. long, triangular flask-shaped without differentiated style; terminal stigma more or less bilobed, 0.4–0.6 mm. long; in male flowers abortive, more or less conical 0.3–1.2 mm. long. *Drupe* ovoid or ellipsoid, often slightly asymmetrical, 7–12 mm. long by 4–8 mm. broad; endocarp hard, 0.2–1 mm. thick, sometimes slightly ridged.

TYPE SPECIES: *Osmanthus austro-caledonicus* (Vieill.) Knobl.

KEY TO SPECIES

1. Petioles up to 1.5 cm. long; inflorescence one per axil terminated by a single flower (FIG. 1, A & B). 2.
2. Inflorescence bracts narrowly triangular or linear, 0.5–3 mm. long, more or less early deciduous; calyx 1–1.5 mm. long with lobes 0.3–1 mm. long; petioles 1–2 mm. broad, 2–10(–15) mm. long; lamina very narrowly to broadly elliptic or occasionally narrowly ovate or obovate, (1.8–)3–7(–9.5) cm. long; apex acute, obtuse or rounded, less commonly subacuminate. 3.
3. Leaves very narrowly elliptic to elliptic or occasionally narrowly ovate or obovate, thickish, more or less coriaceous, (1.8–)3–7(–9.5) cm. long; apex acute, obtuse or rounded, sometimes subacuminate; venation usually with only primary veins visible, sometimes obscurely reticulate; petioles 2–10(–15) mm. long; found from sea level to 1000 m. alt. 1. *O. austro-caledonicus*.
3. Leaves broadly elliptic, thick, coriaceous, 2.8–4.2 cm. long; apex subacuminate; venation with primary veins clearly visible, more or less

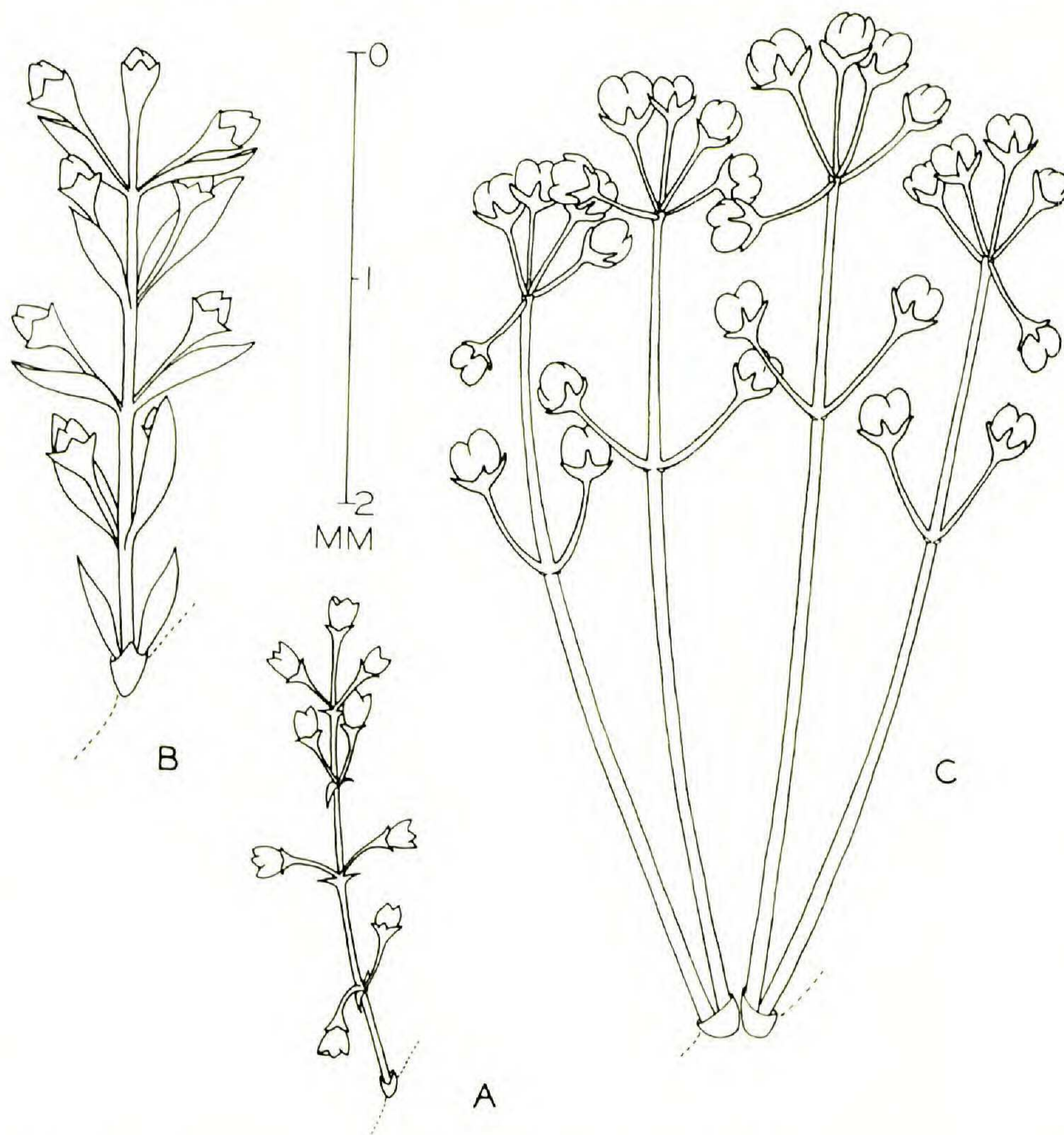


FIG. 1. Types of inflorescence in New Caledonian *Osmanthus*, semidiagrammatic. A, *Osmanthus austro-caledonicus* (White 2184); B, *O. monticola* (Schlechter 15315); C, *O. cymosus* (Balansa 1222).

- reticulate below; petiole 3–4 mm. long; montane habitats, about 1400 m. alt. 2. *O. crassifolius*.
2. Inflorescence bracts subfoliaceous, ovate to lanceolate or elliptic, (2–)3–5 (–12) mm. long, more or less persistent; calyx 2–2.5 mm. long with lobes 1–1.5 mm. long; petioles 3–4 mm. broad, stout, 3–7 (–10) mm. long; lamina elliptic to broadly elliptic (4.5–)6.5–9 (–12.5) cm. long, apex short acuminate to subapiculate. 3. *O. monticola*.
1. Petioles 2.5–3 cm. long; inflorescences 3 to 6 per axil, the five terminal flowers subumbellate (FIG. 1, C). 4. *O. cymosus*.

1. ***Osmanthus austro-caledonicus*** (Vieill.) Knoblauch, Repert. Sp. Nov. 41: 152. 1936; Guillaumin, Bull. Soc. Bot. France 89: 232. 1942, Bull. Mus. Hist. Nat. Paris II. 15: 454. 1943, *ibid.* 28: 314. 1956, Fl. Nouv.-Caléd. 283. 1948 et Mém. Mus. Hist. Nat. Paris II (B). 8: 161. 1959.

Notelaea austro-caledonica Vieillard, Bull. Soc. Linn. Normand. 9: (Pl. Nouv.-Caléd. 16) 345. 1865; Guillaumin, Ann. Mus. Col. Marseille II. 9: 192. 1911.

- N. badula* Vieillard ex Pancher & Sebert in Sebert, Not. Bois Nouv. Caléd. 184. 1872; Jeanneney, Nouv.-Caléd. Agricole, 115. 1894; Schlechter, Bot. Jahrb. 39: 228. 1906; Guillaumin, Ann. Mus. Col. Marseille II. 9: 192. 1911, Bull. Mus. Hist. Nat. Paris. 18: 40. 1912, *ibid.* 19: 522. 1913, *ibid.* 25: 291. 1919, *ibid.* 27: 560. 1921, *ibid.* II. 2: 169. 1930, *ibid.* 4: 701. 1932, *ibid.* 5: 323. 1933, *ibid.* 6: 458. 1934, *ibid.* 13: 476. 1941, in White, Jour. Arnold Arb. 7: 100. 1926, Bull. Soc. Bot. France 89: 232. 1942 et Not. Syst. Paris 11: 55. 1943; Däniker, Viert. Naturf. Ges. Zürich 78 (Beibl. 19): 363. 1933.
- N. collina* Schlechter, Bot. Jahrb. 39: 229. 1906; Guillaumin, Ann. Mus. Col. Marseille II. 9: 192. 1911, Bull. Mus. Hist. Nat. Paris II. 4: 693. 1932, *ibid.* 5: 323. 1933.
- N. eucleoides* Schlechter, Bot. Jahrb. 39: 229. 1906; Guillaumin, Ann. Mus. Col. Marseille II. 9: 192. 1911, Bull. Mus. Hist. Nat. Paris 18: 40. 1912, *ibid.* 25: 652. 1919, *ibid.* II. 6: 458. 1934; Däniker, Viert. Naturf. Ges. Zürich 78 (Beibl. 19): 364. 1933.
- N. vaccinioides* Schlechter, Bot. Jahrb. 39: 230. *fig* 22. 1906; Guillaumin, Ann. Mus. Col. Marseille II. 9: 192. 1911, Bull. Mus. Hist. Nat. Paris 18: 40. 1912, *ibid.* II. 5: 323. 1933, in Sarasin & Roux, Nova Caledonia, Bot. 1: 206. 1921 et in White, Jour. Arnold Arb. 7: 100. 1926; Däniker, Viert. Naturf. Ges. Zürich 78 (Beibl. 19): 364. 1933; Guillaumin, Bull. Soc. Bot. France 89: 232. 1942.
- Osmanthus vaccinioides* (Schltr.) Hochreutiner, Bull. New York Bot. Gard. 6: 284. 1910; Moore, Jour. Linn. Soc. Bot. 45: 356. 1921; Guillaumin, Bull. Soc. Bot. France 89: 233. 1942, Bull. Mus. Hist. Nat. Paris II. 15: 340, 454. 1943, *ibid.* 30: 397. 1958, *ibid.* 31: 179. 1959, Fl. Nouv.-Caléd. 283. 1948, et Mém. Mus. Hist. Nat. Paris II (B). 4: 49. 1953; Virot, Vég. Canaque 175. 1956.
- O. deplanchei* Hochreutiner ex Guillaumin, Ann. Mus. Col. Marseille II. 9: 192. 1911 et Bull. Soc. Bot. France 89: 232. 1942; Nakai, Bot. Mag. Tokyo 44: 15. 1930; *nomen nudum*.
- O. badula* (Vieill.) Hutchinson ex Moore, Jour. Linn. Soc. Bot. 45: 356. 1921; Guillaumin, Bull. Soc. Bot. France 89: 232. 1942, Bull. Mus. Hist. Nat. Paris II. 15: 340, 454. 1943, *ibid.* 20: 371. 1948, *ibid.* 23: 648. 1951, *ibid.* 27: 475. 1955, *ibid.* 30: 397. 1958, Fl. Nouv.-Caléd. 283. 1948, Mém. Mus. Hist. Nat. Paris II (B). 4: 48. 1953, *ibid.* 8: 161. 1959, et Not. Syst. Paris 15: 38. 1954; Virot, Vég. Canaque 211. 1956.
- O. collinus* (Schltr.) Knoblauch, Repert. Sp. Nov. 41: 152. 1936; Guillaumin, Mém. Mus. Hist. Nat. Paris II (B). 8: 161. 1959.
- O. eucleoides* (Schltr.) Knoblauch, Repert. Sp. Nov. 41: 152. 1936; Guillaumin, Bull. Soc. Bot. France 89: 232. 1942, Fl. Nouv.-Caléd. 283. 1948, Mém. Mus. Hist. Nat. Paris II (B). 4: 49. 1953, *ibid.* 8: 161. 1959 et Bull. Mus. Hist. Nat. Paris II. 27: 475. 1955.
- Gymnelaea badula* (Vieill.) L. Johnson, Contr. New S. Wales Natl. Herb. 2: 413. 1957.
- G. collina* (Schltr.) L. Johnson, *loc. cit.*
- G. eucleoides* (Schltr.) L. Johnson, *loc. cit.*
- G. vaccinioides* (Schltr.) L. Johnson, *loc. cit.*
- Nestegis badula* (Vieill.) L. Johnson in Degener, New Ill. Fl. Hawaiian Is. 300. Nestegis. 1958.
- N. collina* (Schltr.) L. Johnson, *loc. cit.*

N. eucleoides (Schltr.) L. Johnson, *loc. cit.*

N. vaccinioides (Schltr.) L. Johnson, *loc. cit.*

Evergreen *shrub* or *small tree* (microphanerophyte) 0.5–3(–7) m. tall; branches glabrous or puberulous, often minutely so. *Leaves* glabrous, sometimes minutely puberulous towards the base of the midrib when young; petiole 2–10(–15) mm. long, glabrous or puberulous, often minutely so; lamina thick or thickish, more or less coriaceous, very narrowly elliptic to elliptic or occasionally narrowly ovate or obovate (FIG. 5), (1.8–)3–7(–9.5) cm. long by (0.3–)0.5–2.5(–3.5) cm. broad; margin entire, slightly thickened, flat or slightly recurved; apex very acute to obtuse or rounded, sometimes subacuminate, tip blunt; base attenuate into the petiole, acute or rarely obtuse; venation usually more or less obscure, often only primary veins visible, 4–7(–8) per side, sometimes obscurely

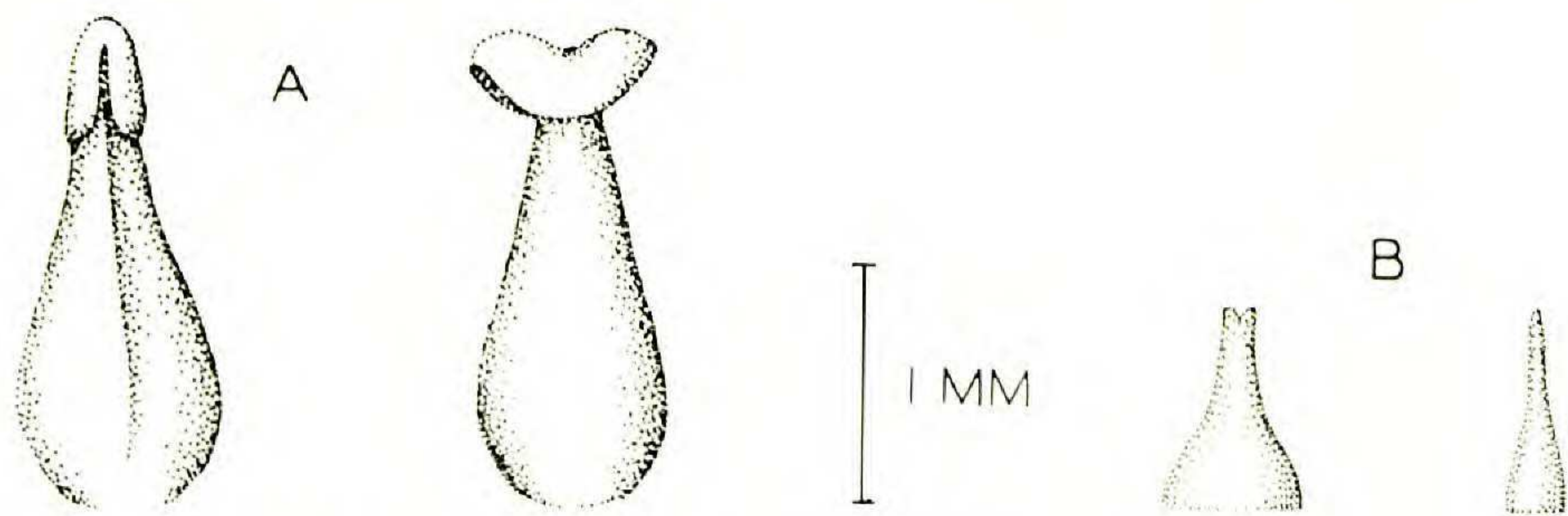


FIG. 2. Ovaries in *Osmanthus austro-caledonicus* from the front and side; A, from an hermaphrodite flower (*Däniker 255*); B, from a male flower (*Pancher 114*).

reticulate. *Inflorescence* axillary, decussate, 1.5–4(–6) cm. long, (5–)7–9(–13)-flowered with a single terminal flower (FIG. 1, A), glabrous or puberulous, often minutely so; bracts narrow triangular or linear 0.5–3 mm. long, deciduous. Flowers androdioecious, white (or yellowish-white, *Baumann-Bodenheim 6291*) scentless (*vide* Compton); pedicels 1–5(–13) mm. long. *Calyx* glabrous or puberulous, 1.5 mm. long, lobes 4, blunt-triangular, 0.3–1 mm. long, margins glabrous or ciliolate. *Corolla* short campanulate, tube (1.2–)1.5–2(–2.5) mm. long, lobes 4, imbricate in the bud, broadly ovate, rounded, (1–)1.5–2(–2.5) mm. long. *Stamens* 2, subsessile near the middle of the corolla tube; anthers 1–2 mm. long in hermaphrodite flowers and 1.5–2.2 mm. long in male flowers, broadly elliptic to slightly ovate, apex rounded with a very slight, blunt (sometimes barely discernible) appendage. *Ovary* in hermaphrodite flowers 1.7–2.2 mm. long, triangular-flask shaped without differentiated style; stigma terminal, more or less bilobed, 0.4–0.6 mm. long (FIG. 2,A); in male flowers abortive, 0.3–1 mm. long, more or less conical, often with a slightly notched apex (FIG. 2,B). *Drupe* dark purple or black when ripe, ovoid to ellipsoid, often slightly asymmetrical, 7–12 mm. long by 4–7 mm. broad, endocarp hard 0.2–0.7 mm. thick, sometimes slightly ridged.

HABITAT: serpentine or ferruginous lateritic soils; river and stream

banks, thickets or heath, scrub, and forest; from sea level to 1000 m. altitude.

Grande Terre: Montagnes de Balade, 1855-60, *Vieillard* 327, 872 & 874 (P); Cap Tonnerre, 1861-67, *Vieillard* 323 (BM, GH, P — as *Osmanthus deplanchei*); am Fusse des Piton Pandop bei Koumac, 20 Feb. 1925, *Däniker* 1300 & 1325 (z); an der nördlichen Erhebung im Kaala Massif bei Koumac, 26 Feb. 1925, *Däniker* 3087a and 19 May 1925, *Däniker* 3087 (z); Montagne de Temala près Gatop, 1861-67, *Vieillard* 2062 (GH, K); Mt. Pouitchaté, on ridge between Upper Tipindjé and Upper Kamendoua, above Atéu, 29 Aug. 1956, *McKee* 5169 (HULL); slopes of Mt. Koniambo, 31 Mar. 1956, *McKee* 4263 (HULL) and 4265 (A, HULL); prope Wagap, *Vieillard* 333 (isotypes: BM, G, K, L, LE, P); Poya valley, road to Roches d'Adio, 18 Oct. 1956, *McKee* 5455 (A); slopes along ocean, 13 miles southeast of Ponérihouen on route to Houailou, 5 Aug. 1952, *McMillan* 5213 (A, E); au point culminant de la route conduisant de Bourail à Canala, 9 Mar. 1869, *Balansa* 1221 (P); collines entourant la Baie Duperré dans la rade de Canala, 2 Sept. 1869, *Balansa* 1682 (P); Kanala, montagne du lac, 1861-67, *Vieillard* 323 (A, GH, P); Canala, 23 Feb. 1912, *Sarasin* 550 (z); rive de la rivière Toou'du, baie de Tupiti, 1861-67, *Vieillard* 328 (A, BM, G, K, LE, P); Île Grand Tupiti, 1861-67, *Deplanche* 432 (G); auf den Bergen am Ngoyé, 31 Oct. 1902, *Schlechter* 15164 (isotypes of *Notelaea eucleoides*: BM, E, K, LE, NSW, P, z) and 15166 (BM, E, FI, GH, K, LE, NSW, P, z); Riv. Ngoyé, 1914, *Compton* 2049 (BM, NSW); north bank of Tontouta River near junction with Kalouéhola, 23 Oct. 1955, *McKee* 3271 (HULL); Upper Tontouta Valley, near Mine Galliéni, 14 Oct. 1956, *McKee* 5447 (NSW); auf der Südwestseite des Mt. Humboldt und an der Tontouta, 2 Nov. 1924, *Däniker* 434 (z); an der Kalouéhola auf der Südwestseite der Mt. Humboldt, 9 Nov. 1924, *Däniker* 434a (z); im Tale des vom Mt. Humboldt kommenden zuflusses der Kalouéhola, 3 Nov. 1924, *Däniker* 468 (z); am Abhang der Südcrête des Mt. Humboldt, 6 Nov. 1924, *Däniker* 468a (z); Mt. Dzumac, *Le Rat* 155 & 1073 (P); bas du Mt. Dzumac, 28 Apr. 1951, *Guillaumin & Baumann-Bodenheim* 12693 (A, z); auf den Huegeln bei Paita, 28 Sept. 1902, *Schlechter* 14834 (isotypes of *Notelaea collina*: BM, E, K, LE, NSW, P, z); auf den Bergen bei Paita, 9 Oct. 1902, *Schlechter* 14976 (isotypes of *Notelaea vaccinioides*: BM, E, FI, GH, K, LE, NSW, P, z); le long des rivières Couvelée, 1 Nov. 1929, *Franc* 2405 (A, BRI, E, K, NSW, NY, z); ravin de la Couvalée, 1907, *Le Rat* 2842 (P); Mts. Kouvelée moyens, 9 May 1951, *Guillaumin & Baumann-Bodenheim* 13066, 13072, 13085 & 13170 (A, z); Dumbéa, *Le Rat* 2385 (A) & Sept. 1909, *Le Rat* 924 (K, LE, P); rives de la Dumbéa audessus de Koé, 1868, *Balansa* 531, (LE, P), 531a (A, P) & 1220 (BM, E, FI, G, K, LE, NY, O); près de la dernière trémie de la mine Sunshine, concession Werquin, Haute Dumbéa branche Nord, 29 Nov. 1942, *Virost* 903 (A); Dumbéa valley, north bank, 8 May 1955, *McKee* 2477 (HULL); vallée de la Dumbéa-Nord, 14 Mar. 1951, *Hürlimann* 1041 (A, z); pente N. des montagnes entre le Pic de Casse-Cou et la Dumbéa, 7 Mar. 1951, *Hürlimann* 1014 (A, z); massif du Tchingou entre P 743 et P 1187, 17 Apr. 1951, *Hürlimann* 1214 (A, z); plaine de l'Odjijoni, 2 June 1951, *Hürlimann* 1457 (A, z); chaîne du Mont Podchoumié, 27 July 1951, *Hürlimann* 1626 (A, z); bas de l'Oua Tilou, 13 Apr. 1951, *Guillaumin & Baumann-Bodenheim* 12304 (A, z); route vers la Montagne des Sources, 5 Dec. 1950, *Hürlimann* 248 (A, z) and 28 Jan. 1956, *McKee* 3868 (HULL, K); Crête am Mt. Koghi, 1 Feb. 1926, *Däniker* s. n. (z); summit ridge of Mt. Koghi, 25 Feb. 1956, *McKee* 4008 (A, K); crête au SW. du Mt. Bouo (Koghis), 6 Nov. 1951, *Baumann-Bodenheim* 15808 (A, z); crête au SE. du Mt.

Bouo (Koghis), 20 Apr. 1951, *Guillaumin & Baumann-Bodenheim* 12565, 12629 & 12631 (A, z); à l'Est de la Conception, Dec. 1868, *Balansa* 1220a (P); Mt. Dore, 1861-67, *Vieillard* 228 (GH) and 1 May 1955, *McKee* 2457 (HULL); pente N. du Mt. Dore, 8 Nov. 1950, *Guillaumin & Baumann-Bodenheim* 7861 & 7871 (A, z); versant E. du Mt. Dore, 21 Mar. 1951, *Guillaumin & Baumann-Bodenheim* 11338 & 11357 (A, z); vallée de la Pouéta Kouré, 26 Aug. 1950, *Hürlimann* 21 & *Baumann-Bodenheim* 5750 & 5754 (A, z); Col de Volcain, 11 Nov. 1950, *Baumann-Bodenheim* 8054, 8085, 8159, 8162, 8163, 8167 & 8267 (A, z) and 24 Sept. 1951, *Baumann-Bodenheim* 15542 (A, z); sur la Rivière Blanche, 22 Feb. 1951, *Guillaumin & Baumann-Bodenheim* 10837 & 10845 (A, z); bord du Marais Kiki, 26 Sept. 1950, *Baumann-Bodenheim* 6291 (A, z); Mt. Kaféaté, 22 Dec. 1950, *Guillaumin & Baumann-Bodenheim* 9627, 9667 & 9695 (A, z); Col de Plum, 22 Aug. 1950, *Baumann-Bodenheim* 5535, 5554 & 5599 (A, z); vallée supérieure de la Rivière des Pirogues, 29 Mar. 1951, *Guillaumin & Baumann-Bodenheim* 11605 (A, z); crête ou SW. du P 247 (W. de la Baie des Pirogues), 17 Dec. 1950, *Hürlimann* 380 (A, z); Ria de Pirogues, Oct. 1923, *White* 2184, 2200 (A, BRI, K) & 2267 (A, BRI, K, O, P); Baie du Carénage, 22 July 1952, *McMillan* 5132 (A, E); Le Carénage, 8 Apr. 1955, *McKee* 2370 (A, HULL, NSW); Col d'Amieu, 13 Aug. 1950, *Baumann-Bodenheim* 5468 (z); Champ de Bataille in Tale des Ngo, 15 Oct. 1924, *Däniker* 346 (z); Prony, Sept. 1913, *Franc* 1537A (A, BRI, NY, z), Mar. 1914, *Franc* 114 (A, BM, BRI, E, K, LE, NSW, NY, O, P, z) & 114 A (A, BM, GH, NY, P, z) and 20 Jan. 1916, *Franc* 2011 (P); Baie de Prony, Sept. 1910, *Godefroy* 180 (P); Baie du Sud, 1903, *Le Boucher* 1508 (NSW); Val Suzon, 30 July 1930, *Franc* 2480 (A, BRI, E, K, NSW, NY, z); Yaté, 16 Mar. 1912, *Sarasin* 639 (P, z); Plaine des Lacs und oberen Yaté, ges. im Yatétal, 8 Oct. 1924, *Däniker* 255 (z); in der Plaine des Lacs, 12 Oct. 1924, *Däniker* 297 (z); beim Lac en 8, Plaine des Lacs, 12 Oct. 1924, *Däniker* 304 (z). Without locality: *Baudouin* 634 (P), *Deplanche* 14 (A, K), *Franc* 192 (z), *Kay* 26 (P), *Pancher* 114 (A, K, P) & s.n. (? type collection, *Notelaea badula*, P) and *Vieillard* 2861 (P).

Isle of Pines: creek sur la pente S. du Pic Nga, 29 May 1951, *Baumann-Bodenheim* 13691 (A, z); flanc NE. du Pic Nga, 1 June 1951, *Baumann-Bodenheim* 13842 (A, z).

The reduction of so many species to synonymy may at first appear somewhat drastic but from a thorough study of the numerous collections which have been assembled and cited above, I am convinced that they all represent facets of one and the same species.

When the flowers of each individual specimen were examined it soon became apparent that they were androdioecious, a condition also found in all the species of Section *Osmanthus* and in some species of related genera (e.g. *Olea dioica*). In the hermaphrodite flowers the ovary is fully developed and topped by a bilobed stigma (FIG. 2,A) whereas in those which are functionally male it is much smaller, more or less conical and lacks the stigmatic lobes (FIG. 2,B). Nor is the sex difference confined to the ovary alone for measurements were made of the length of the anthers and it was found that whilst the sizes for the two sex forms overlapped, those for the functionally male flowers were larger on the average (for dimensions see the description above). In all some 68 different collections bearing flowers were examined and of these 32 were hermaphrodite and

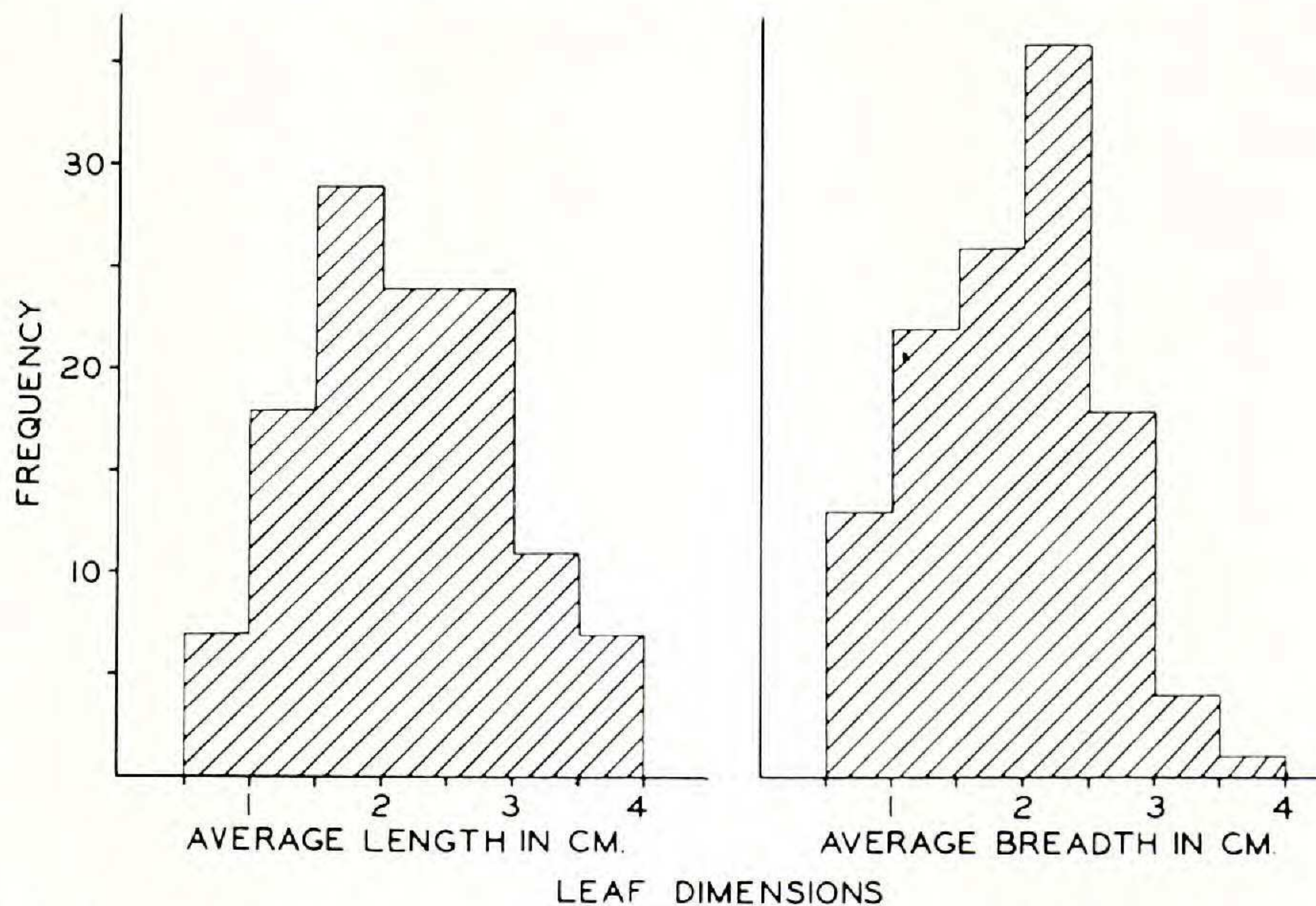


FIG. 3. Frequency histograms for leaf length and breadth in *Osmanthus austro-caledonicus*.

36 male; from this it may be safely assumed that the two forms occur in equal numbers, as might perhaps be expected. The failure to recognize that the ovaries of the type specimens of *Osmanthus austro-caledonicus* and *O. vaccinioides* were the abortive ovaries of male flowers led to their being contrasted with the larger functional ovaries possessing distinct stigmatic lobes in specimens named *O. badula* and *O. eucleoides*. Guillaumin in the Key presented in his *Flore de la Nouvelle-Calédonie* (p. 284) uses stigma size to separate these species. If, however, in the light of the occurrence of androdioecism, one discounts these differences then one is left with two instead of four possible species, and these are distinguished by leaf shape.

The diagnostic value of leaf shape was therefore considered, and the numerous collections cited above were analyzed for leaf length, breadth and outline. It soon became evident, as was suspected from a purely visual appraisal, that continuous variation exists between the two extremes of a very narrowly elliptic leaf on the one hand and a narrowly ovate to obovate outline on the other. Measurements of leaf length and leaf breadth for each collection when plotted in the form of a frequency histogram showed a normal variational spread (FIG. 3). Nowhere could the material be separated into discrete groups and the separation of species by leaf shape alone was found to be purely artificial. The specimens were also examined for other possible characters which could perhaps be used for the differentiation of separate taxa, e.g. characters of the petiole, leaf apex, base and venation, inflorescence and flowers, but nothing was found to justify any subdivision of the material. In fact, apart from androdioecism the flowers throughout were identical, which in itself is strong evidence that one is dealing with a single species.

Measurements of a leaf length-breadth factor (the length divided by the breadth) were plotted in the form of a frequency histogram (FIG.

4) and it was seen that relatively few specimens with proportionately broad and long leaves (FIG. 5,A) had been collected; generally they were either long and narrow (FIG. 5,B) or short and broad (FIG. 5,C). This observation led to an examination of the field notes accompanying the specimens and it was found that wherever the habitat was mentioned, the long and narrow-leaved specimens, in almost all cases, came from the banks or margins of streams, rivers, mountain torrents, etc., whereas most of those with the shortest and broadest leaves came from heath, maquis, scrub, forest, etc. This raised the question whether the narrow leaves might be an adaptation to periodic immersion in swiftly flowing water; in other words, could the plants be rheophytes? Van Steenis in an article on rheophytes (Proc. Roy. Soc. Queensland, 62: 61-68. 1952) mentions *Notelaea* from New Caledonia, and Schlechter in his account of the vegetation of New Caledonia (Bot. Jahrb. 36: 1. 1905) includes *N. badula* as an interesting species characteristic of river courses. In the introductory paragraph to the account of species he collected (Bot. Jahrb. 39: 228. 1907) Schlechter remarks that *N. badula*, *N. collina*, and *N. eucleoides* seek the banks of water courses whereas the other species (including *N. vaccinioides*) are found in woods. But if, as I am convinced, one is dealing here with a single species and it is stenophyllous only when growing by the side of mountain torrents, etc., then one has a case of facultative rheophytism. Although Dr. van Steenis informs me, in correspondence, that in an overwhelming number of cases rheophytes are good species, from the material examined in this revision, any separation, even at the rank of variety, appears to be artificial. Facultative rheophytism would infer that the stenophyllous habit was phenotypic and develops only where the plant is subject to periodic inundation. Not only is it doubtful whether a strong but intermittent current of water could produce such an

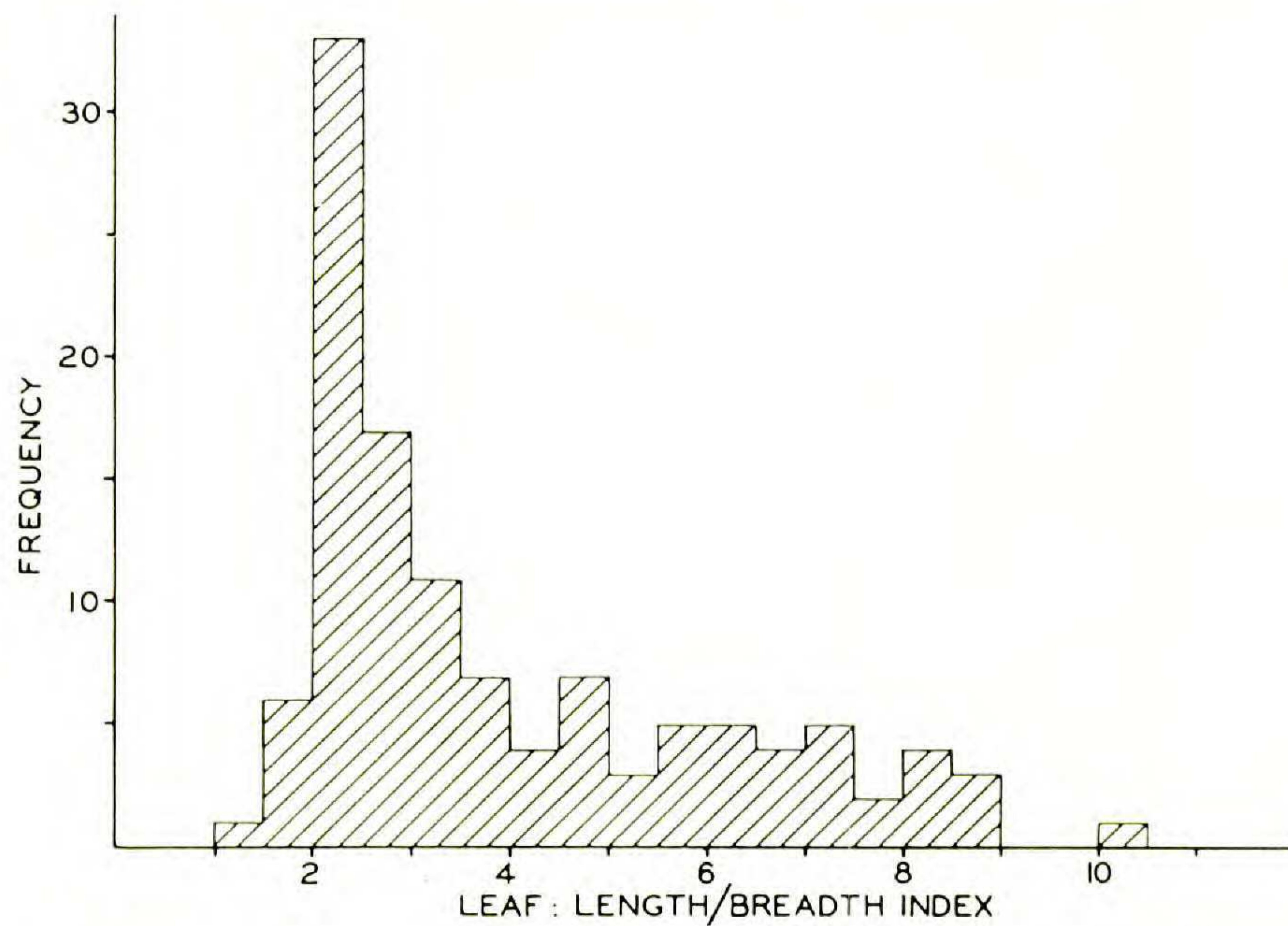


FIG. 4. Frequency histogram for leaf length/breadth factor in *Osmanthus austro-caledonicus*.

effect but amongst the many collections examined one might reasonably expect to find gatherings made from trees which bear more than one type of leaf, where the lower branches only are subject to immersion. In no case however, has such a condition been found in these collections. Moreover, there are occasional exceptions to the rule that the narrow-leaved specimens have been collected from river banks, etc.: *Baumann-Bodenheim* 8159 is perhaps the best, for it was collected in serpentine maquis at the same locality and on the same day as numbers 8054, 8085, 8162, 8163, 8167 and 8267, yet it is the only one of these numbers with extremely narrow leaves. *Guillaumin & Baumann-Bodenheim* 13066, 13072, 13085 and 13170 all exhibit very narrow leaves, yet for all of them the field notes say "forêt mésophile sur serpentine."

An alternative explanation was suggested by my colleague Dr. Lorin I. Nevling who pointed out that stenophylly is one of the recognized features of plants growing in serpentine soils, in temperate regions at least. *Osmanthus austro-caledonicus* is a serpentine endemic. Could it be that in New Caledonia the serpentine effect is more intense in some areas than in others, due perhaps to severe leaching by the tropical rains, with the result that stenophylly tends to be greater in some local areas than in others? These areas might include those where the subsoil was continuously disturbed or exposed (such as river and stream banks), or the effect might be due to differences in the size of soil particles with all the physico-chemical effects that might be attributable to this (and on a stream bank the percentage of coarse soil particles is greater than in undisturbed soil). Most of the literature on the vegetation of serpentine soils deals with that of the temperate regions of Europe and North America and no published observations have been found to support the hypothesis that a differential effect on leaf shape based on edaphic factors may be found within a serpentine endemic. The problem of *O. austro-caledonicus* calls for studies in the field combined, if possible, with transplant and other experimental techniques.

The original holotypes of Schlechter's species were presumably destroyed in Berlin during the Second World War but fortunately duplicates of his collections were widely distributed and many isotypes are available. Neither has the holotype of *Notelaea austro-caledonica* been seen. Vieillard in his protologue cites one gathering, *Vieillard* 333, the holotype of which is suspected to be in the herbarium at Caen in Normandy; however, three duplicates have been examined in the course of this investigation. Although he only cited one gathering Vieillard must have examined other material as well when he drew up his description, for the flowers of *Vieillard* 333 prove on examination to be functionally male whilst in his description he includes references to the style, stigma and fruit. No actual specimens or collections are cited for *N. badula* but an unnumbered specimen at Paris collected by Pancher in 1862 is annotated as "type collection." No locality is given, only "Massifs de la Calédonie et de l'Île des Pins" in Pancher's hand, together with "Olea convoluta de la corolle ou punctata des feuilles. Arbre de 5 metres, cime arrondie, dense.



FIG. 5. Shoots of: A, "*Osmanthus collinus*" (Schlechter 14834); B, "*O. badula*" (Franc 2405); C, "*O. vaccinioides*" (Schlechter 14976). ($\frac{1}{2}$ natural size.)

Fleurs blanches, Juin-Septembre, selon les localités. Bois très dur." Some of these phrases appear in the protologue and even though this may perhaps not be the type, since the epithet is attributed by Pancher to Vieillard, who does not appear to be associated with this specimen, and since as its flowers are functionally male it bears no fruit (as described in the protologue), it may nevertheless be taken as authentic and used to indicate the proper application of this name.

Finally, one or two specimens (e.g. *Däniker 8087* and *McKee 2370*) may be slightly confusing at first sight as they bear galled flowers in which the bud is attacked and never opens. The corolla tube enlarges and lengthens considerably and presumably persists, for some specimens show both fruit and galled flowers.

2. *Osmanthus crassifolius* Guillaumin, Mém. Mus. Hist. Nat. Paris II (B). 4: 48. 1953; Virot, Vég. Canaque 218. 1956.

Evergreen glabrous *shrub* 5 m. tall. *Leaves* glabrous; petioles 3–4 mm. long; lamina coriaceous broadly elliptic, 2.8–4.2 cm. long by 1.7–2.5 cm. broad; margin entire, slightly thickened and recurved; apex short acuminate; base attenuate into the petiole; venation more or less reticulate below, primary veins only visible above, 7–8 per side. *Inflorescence* axillary, decussate, 1.5–2 cm. long, 7-flowered, with a single terminal flower, glabrous; bracts linear-triangular 1–2 mm. long. Flowers androdioecious, white; pedicels 1–2 mm. long. *Calyx* glabrous 1.5 mm. long, lobes 4, blunt, broadly triangular, 0.8–1 mm. long, margins glabrous. *Corolla* short campanulate, tube 1.5 mm. long, lobes 4, imbricate in the bud, broadly ovate-rounded, 1.5 mm. long. *Stamens* 2, subsessile near the middle of the corolla tube; anthers 1.4 mm. long in a male flower, very broadly elliptic, apex rounded with a very slight blunt appendage. *Ovary* not seen in hermaphrodite flowers, in male, abortive, 0.4 mm. long, slightly conical. *Drupe* unknown.

HABITAT: Serpentine, maquis, 1400 m. alt.

Arête méridionale du Humboldt, 12 Dec. 1940, *Virot 339* (holotype, p).

Osmanthus crassifolius is retained as a distinct species in this revision with a considerable measure of doubt. It is very similar to *O. austro-caledonicus* but in vegetative morphology it lies just outside the range of variation of this species and so until more material is available for study it seems advisable to maintain its separate recognition. In characters of the inflorescence and flower, however, there appears to be no differentiation at all; yet such a difference might reasonably be expected in two distinct species.

The type, *Virot 339*, was collected at an altitude of 1400 meters which is comparable with that for *Osmanthus monticola* and some 400 meters higher than any recorded altitudes for *O. austro-caledonicus*, although from the localities it is suspected that some *Däniker* specimens of the latter species may have been collected from above 1000 meters. It is possible that the thicker, broadly elliptic leaves are a response to altitude or,

alternatively, that hybridization may occasionally occur between *O. austro-caledonicus* and *O. monticola*. Both species grow on Mount Humboldt and whilst the suggestion of hybridization, when so little is known about the species, is almost too facile a hypothesis, in leaf characters the type of *O. crassifolius*, the only known specimen, is intermediate between the two species.

The collection of Viro, however, is not the only one difficult to place; two others have been collected from montane, serpentine heath and are represented in the herbaria of the Arnold Arboretum and Zürich: *Baumann-Bodenheim 15361* (western summit of Mt. Humboldt, 1400 m. alt., 20 Sept. 1951) and *Hürlimann 1652* (slope to the N. E. of summit of Mt. Moné (Koghis), 1060 m. alt., 28 July 1951). These also show somewhat intermediate characters. In the former the leaves (3 to 6 cm. long) are too short to be *Osmanthus monticola*, and the remains of an inflorescence rachis shows bracts like those in *O. austro-caledonicus*, but the texture, shape, and general appearance of the leaves with their short acuminate apices is very strongly reminiscent of *O. monticola*. It is interesting, too, that on one of the sheets of *Däniker 468* (z), here named *O. austro-caledonicus*, there is one small shoot which does not conform with the rest of the material under this number, yet is an exact match for part of *Baumann-Bodenheim 15361*. It is perhaps also significant that this sheet is an obvious mixed collection since the remainder of the material contains both sex forms and was, in consequence, named *O. eucleoides* in part and *O. vaccinioides* in part by Knoblauch in 1935. No altitude is given for the gathering but it was collected on the slopes of Mt. Humboldt. The other anomalous specimen, *Hürlimann 1652*, was collected on Mt. Koghis, from which *O. monticola* has not been collected, and from as low as 1060 meters. However, although the smaller leaves resemble the short broad-leaved expression of *O. austro-caledonicus* the larger ones (up to 6 cm. long) are broadly elliptic, and thick in texture, resembling small leaves of *O. monticola*. It also bears very immature inflorescences (with large bracts which when mature may well be subfoliaceous) which certainly resemble immature inflorescences of *O. monticola* rather than of *O. austro-caledonicus*.

Clearly more collecting, mindful of the variation and altitudinal ranges of the known species, is required to elucidate the true status and exact differentiation of *Osmanthus crassifolius*.

3. *Osmanthus monticola* (Schltr.) Knoblauch, Repert. Sp. Nov. 41: 152. 1936; Guillaumin, Bull. Soc. Bot. France 89: 232. 1942, Fl. Nouv.-Caléd. 283. 1948, Mém. Mus. Hist. Nat. Paris II(B). 4: 49. 1953, *ibid.* 8: 161. 1959; Viro, Vég. Canaque 218. 1956.

Notelaea monticola Schlechter, Bot. Jahrb. 39: 229. 1906. Guillaumin, Ann. Mus. Col. Marseille II. 9: 192. 1911 et Bull. Mus. Hist. Nat. Paris 18: 40. 1912.

Gymnelaea monticola (Schltr.) L. Johnson, Contr. New S. Wales Natl. Herb. 2: 413. 1957.

Nestegis monticola (Schltr.) L. Johnson in Degener, New Ill. Fl. Hawaiian Is. 300. *Nestegis*. 1958.

Evergreen *shrub* or *tree*, 1–10 m. high; branches glabrous or minutely puberulous when young. *Leaves* glabrous; petioles stout 3–7(–10) mm. long, glabrous or minutely puberulous when young; lamina very thick, coriaceous, pale beneath and dark above even when dried, elliptic to broadly elliptic (4.5–)6.5–9(–12.5) cm. long by (1.5–)2–4.5(–6) cm. broad; margin entire, somewhat thickened, more or less recurved; apex acute, short, very short acuminate or subapiculate; base attenuate into the petiole; venation with reticulations more or less visible, primary veins visible above and below, 6–7(–10) per side. *Inflorescence* axillary, decussate, 2–4.5 cm. long, (7–)9–13-flowered, with a single terminal flower, minutely puberulous; bracts ovate to lanceolate or elliptic, subfoliaceous, (2–)3–5(–12) mm. long, more or less persistent (FIG. 1,B). Flowers androdioecious, white; pedicels 2–5 mm. long. *Calyx* minutely puberulous or glabrate, 2–2.5 mm. long, lobes 4, bluntly and broadly triangular, 1–1.5 mm. long, minutely ciliolate. *Corolla* short campanulate, tube 2.5–2.8 mm. long, lobes 4, imbricate in the bud, broadly ovate-rounded, 1.6–2 mm. long. *Stamens* 2, subsessile near the middle of the corolla tube; anthers about 1.5 mm. long, in hermaphrodite flowers and 2.5 mm. long in male flowers, broadly elliptic to slightly ovate, apex with a barely discernible appendage. *Ovary* in hermaphrodite flowers 2.5 mm. long, triangular-flask shaped without differentiated style; stigma terminal, more or less bilobed, 0.5 mm. long; in male flowers abortive, 1–1.2 mm. long, slightly conical. *Drupe* ovoid-ellipsoid, 11 mm. long by 8 mm. broad (*Baumann-Bodenheim* 15481); endocarp hard, 1 mm. thick.

HABITAT: Serpentine soils, rocky maquis or hygrophilous forest, montane, 1100 to 1600 m.

Auf den Abhängen des Mt. Humboldt, 16 Nov. 1902, *Schlechter* 15315 (isotypes: BM, E, K, LE, P, Z); arête méridionale du massif du Humboldt, 12 Dec. 1940, *Viot* 426 (A); crête S. et sommet secondaire du Mt. Humboldt, 23 Sept. 1951, *Baumann-Bodenheim* 15481 & 15523 (A, Z); crête ouest du Mt. Humboldt, 19 Sept. 1951, *Baumann-Bodenheim* 15344 (A, Z); à l'ouest du sommet du Mt. Humboldt, 21 Sept. 1951, *Baumann-Bodenheim* 15433 (A, Z); Mt. Mou, Aug. 1908, *Le Rat* 203 (P); sommet du Mont Mou, 13 Mar. 1951, *Guillaumin & Baumann-Bodenheim* 11238 (A, Z).

Quite distinct from *Osmanthus austro-caledonicus*, this species is known only from higher altitudes on two of the higher mountains towards the southern part of the island. *O. crassifolius*, and the two specimens discussed under it, blur the differences between *O. monticola* and *O. austro-caledonicus*, whilst the great range in leaf variability in this last makes it difficult to distinguish and use diagnostic vegetative characters in a key for specific identification. The flowers of *O. monticola* are much larger in their various parts and the subfoliaceous bracts of the inflorescence give a ready character for differentiation, but even in purely vegetative specimens its leaves are distinctive. They are broadly or very broadly

elliptic and generally longer than those of *O. austro-caledonicus*. The leaves are also very much thicker in texture than *O. austro-caledonicus*, and in contrast to this very variable species, are remarkably uniform in general shape, texture, and dimensions.

Schlechter in his protologue describes this species as a tree 10 m. tall but Viro (La Végétation Canaque, 218. 1952) classifies it as a nanophanerophyte and, in the field notes accompanying his specimen number 426, describes it as a shrub 1 m. high. The recent collections of the 1950–52 Franco-Swiss Expedition, whilst indicating a height of as much as 4 m. for one of the gatherings (*Baumann-Bodenheim 15344*), state that two others are only 1 m. high. However, like the Viro specimen, they are mature enough to bear flowers and fruit. Within its family, the Oleaceae, this species is somewhat unique in reaching maturity at so low a stature yet with such relatively large leaves, but as a New Caledonian serpentine endemic it is probably no more remarkable in the field than many other unrelated plants growing together in the same vegetational communities.

4. *Osmanthus cymosus* (Guillaumin) P. S. Green, comb. nov.

Notelaea? *cymosa* Guillaumin, Bull. Soc. Bot. France 89: 232. 1943 et Fl. Nouv.-Caléd. 283. 1948; Johnson, Contr. New S. Wales Natl. Herb. 2: 411. 1957.

Shrub (?) or small tree (?); branches minutely puberulous when young, later glabrous. *Leaves* glabrous; petiole 2.5–3 cm. long, glabrous or minutely puberulous when young; lamina thickish, broadly elliptic or almost narrowly ovate, 6.5–11.5(–16) cm. long by 3.5–5.5(–7.5) cm. broad; margin entire, very slightly thickened, flat; apex rounded-obtuse; base attenuate into the petiole, more or less obtuse; venation more or less reticulate above and below, with 8–10 primary veins per side. *Inflorescence* axillary, decussate, 3–6 arising from 1–2 superposed buds, each 2.5–6 cm. long, slender, minutely puberulous, (5–)7–9-flowered, with usually 5 flowers borne together terminally (FIG. 1,C); bracts ovate, 1 mm. long, early deciduous. Flowers androdioecious (?), pedicels 4–12 mm. long. *Calyx* glabrous, 1–1.5 mm. long, lobes 4, blunt triangular, 0.5–1.7 mm. long, margins more or less ciliolate. *Corolla* short campanulate, tube 1.5–1.7 mm. long, lobes 4, imbricate in the bud, very broadly ovate, rounded, 0.7–1 mm. long. *Stamens* 2, subsessile near the middle of the corolla tube; anthers 1.6 mm. long in male flower, more or less orbicular, apex rounded with barely discernable terminal appendage. *Ovary* (male flower only examined) abortive, more or less conical, 0.5 mm. long. *Drupe* unknown.

HABITAT: montane forest.

Mont Mi, 9 March 1869, *Balansa 1222* (holotype [not seen] and isotype, P).

Most distinct because of its fasciculate inflorescence with slender relatively few-flowered rachises and usually five flowers arising together terminally (FIG. 1,C). The inflorescence is basically decussate as in the other

species but the terminal subumbellate group of five pedicels would seem to be a contraction of the apical group of three, together with the penultimate pair normally (cf. *Osmanthus austro-caledonicus*) borne below. The large more or less elliptic leaves on relatively long petioles are also distinctive and it is a pity that for a more ample description and better assessment of this species, more adequate material is not available, the species having been collected once only, nearly one hundred years ago.

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